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ON THE USE OF MAGNESIUM IN STUPEFYING MARINE ANIMALS.

ALFRED G. MAYER.

It is well known that Tullberg, 1892, discovered that an excess of magnesium added to sea-water causes anesthesia in marine animals, thus permitting them to be killed in an expanded state.

During the course of some physiological experiments carried out at the Marine Laboratory of the Carnegie Institution of Washington at Tortugas, Florida, I found that marine animals can be anesthetized much more rapidly and completely than by Tullberg's method if we simply place them in a pure aqueous solution of MgSO_4 or MgCl_2 of three eighths molecular concentration. They then subside into complete relaxation without initial stimulation, and after remaining for an hour or two in the solution they may be killed in any manner whatsoever without becoming distorted through contraction. Some distortion is often produced in Tullberg's process, due to the calcium and sodium of the sea-water, but in a pure aqueous solution of magnesium the relaxation of the muscles is complete. This method has been tried upon scyphomedusæ, ctenophoræ, actinians, annelids, nemertians, phascolosoma, and nudibranchs with marked success, and appears to be especially suitable for the stupefying of highly sensitive and contractile marine animals which become hopelessly distorted if killed by ordinary methods.

It is interesting to observe however that while magnesium is the most potent anesthetic for the neuro-muscular system it is the most powerful stimulant among the ions of sea-water or of blood-salts for the movement of cilia. Indeed I find that the ions of Na, Mg, K and Ca affect cilia in a manner the exact *opposite* of their effect upon muscles and nerves. Thus Na is the most powerful neuro-muscular stimulant, and the most pronounced inhibitor for the movement of cilia. Mg is the greatest inhibitor for nerves and muscles and the strongest stimulant for the movement of cilia. A weak concentration of K at first excites and then depresses the

neuro-muscular system, and at first subdues and afterwards stimulates the movement of cilia. Ca is a depressant for nerves and muscles but a weak stimulant for cilia. NH_4Cl is a primary stimulant for muscles but soon produces depression, while upon cilia its effect is the reverse, a primary cessation of movement being followed by recovery. The CO_2 ion inhibits muscular activity, while in weak concentration it produces a primary depression of cilia followed by a recovery of movement.